STANFORD RESEARCH INSTITUTE
Menlo Park, California 94025 · U.S.A.

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Proposal for Research
SRI No. ISU 75-241

MAGNETOMETER STABILITY STUDIES

Prepared for:

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I INTRODUCTION

This unsolicited proposal is submitted to request authorization for an additional task effort on Naval Electronics Systems Command Contract No. N00039-76-C-0077, a project investigating interactions between human subjects and electromagnetic systems.

The additional task effort, proposed herein, is directed toward determining the nature of perturbation effects induced in sensitive cryomagnetometers by the proximity of certain human subjects. The observation of such effects has profound implications for projects which require a nonferrous environment free from interference and magnetic contamination, such as magnetic object detection, magnetic signature classification, magnetic sensor design, and magnetics test procedures.

SRI proposes to undertake a 4.4 man-month (including subjects) research program to investigate the characteristics of, and if possible to determine the mechanisms responsible for, human-subject-mediated perturbation effects.

II BACKGROUND

For the past three years we have had a program in the Electronics and Bioengineering Laboratory of SRI to investigate those conditions of energy interchange between human subjects and the environment which appear to fall outside the range of well-understood interactions. Of particular interest is a class of phenomena involving perturbations of sensitive measurement apparatus by certain human subjects under conditions generally accepted as providing sufficient isolation, by reason of distance or shielding, so as to prevent the occurrence of such perturbations. Furthermore, the generation of such effects appears to be under volitional control of the subjects involved. Following is a description of two observations involving the perturbation of cryomagnetometers.

A. Shielded-Magnetometer Observation (Pilot Experiment)

One of the first intentionally induced physical perturbation effects observed by SRI personnel (H.P.) in early research (1972) was the apparent perturbation of a superconductor-shielded Josephson effect magnetometer by a gifted subject, S3.* Following is a fairly detailed account of that first observation, since it reveals a number of aspects of research in this area that we consider to be of significance.[1]

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*SRI program subjects S1 and S3 involved in magnetometer studies are, respectively, Mr. P. Price and Mr. I. Swann.

This magnetometer is located in a well under a building and is shielded by μ-metal shielding, an aluminum container, copper shielding, and, most important, a superconducting shield. (See Figure 1.) The magnetometer, developed under an ONR contract at Stanford University, is of the superconducting quantum interference device (SQUID) variety, which has an output voltage whose frequency is a measure of the rate of change of magnetic field present.

Before the experiment, a decaying magnetic field had been set up inside the magnetometer, and its decay with time provided a background calibration signal that registered as a periodic output on an x-y recorder, the frequency of the output corresponding to the decay rate of the calibration field ($\sim 10^{-6}$ G). The system had been running for about an hour with no noise.

Subject S3 was shown the setup and told that if he were to affect the magnetic field in the magnetometer, it would show up as a change in the output recording. Then, to use his own description, he placed his attention on the interior of the magnetometer, at which time the frequency of the output doubled for about two of the cycles or roughly 30 seconds. This is indicated by A in Fig. 2. S3 was next asked if he could stop the field change being indicated by the periodic output on the recorder. He then apparently proceeded to do just that, as can be seen at B in the graph, for a period of roughly 45 seconds. He then "let go," at which time the output returned to normal (C). Upon inquiry as to what he had done, he explained that he had direct vision* of the apparatus inside and that the act of looking at different parts seemed to him to be correlated with the different effects. As he described what he was doing, the recording again traced out a double frequency cycle (shown at D), as had occurred before. An atypical dip (E) in the recording took place then, and on questioning him about what was happening, he said he was looking at a new part, the niobium ball sitting in a cup. This ball was inert at the time, not being used in the magnetometer experiment. He was asked to refrain from thinking about the apparatus and the normal pattern was then traced out for several minutes (continued on lower trace) while he was engaged in conversation on other subjects. At one point he started to discuss the magnetometer again, at which point the tracing went into a high frequency pattern, shown at F. At our request he stopped, and the observation was terminated because S3 was tired from his effort. We then left the lab, while the apparatus was run for over an hour with no trace of noise or nonuniform activity, as indicated in Fig. 3, where the top two traces show a continuing record following termination of the experiment. The third trace was taken some time later, the increase in the period indicating the reduced rate of magnetic field decay. At various times during this and the following day when similar data with S3 were taken, the experiment was observed by numerous other scientists.

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*This ability to view remote locations thought to be secure against such access is designated "remote viewing," and has been thoroughly documented in a separate SRI program.[2,3]

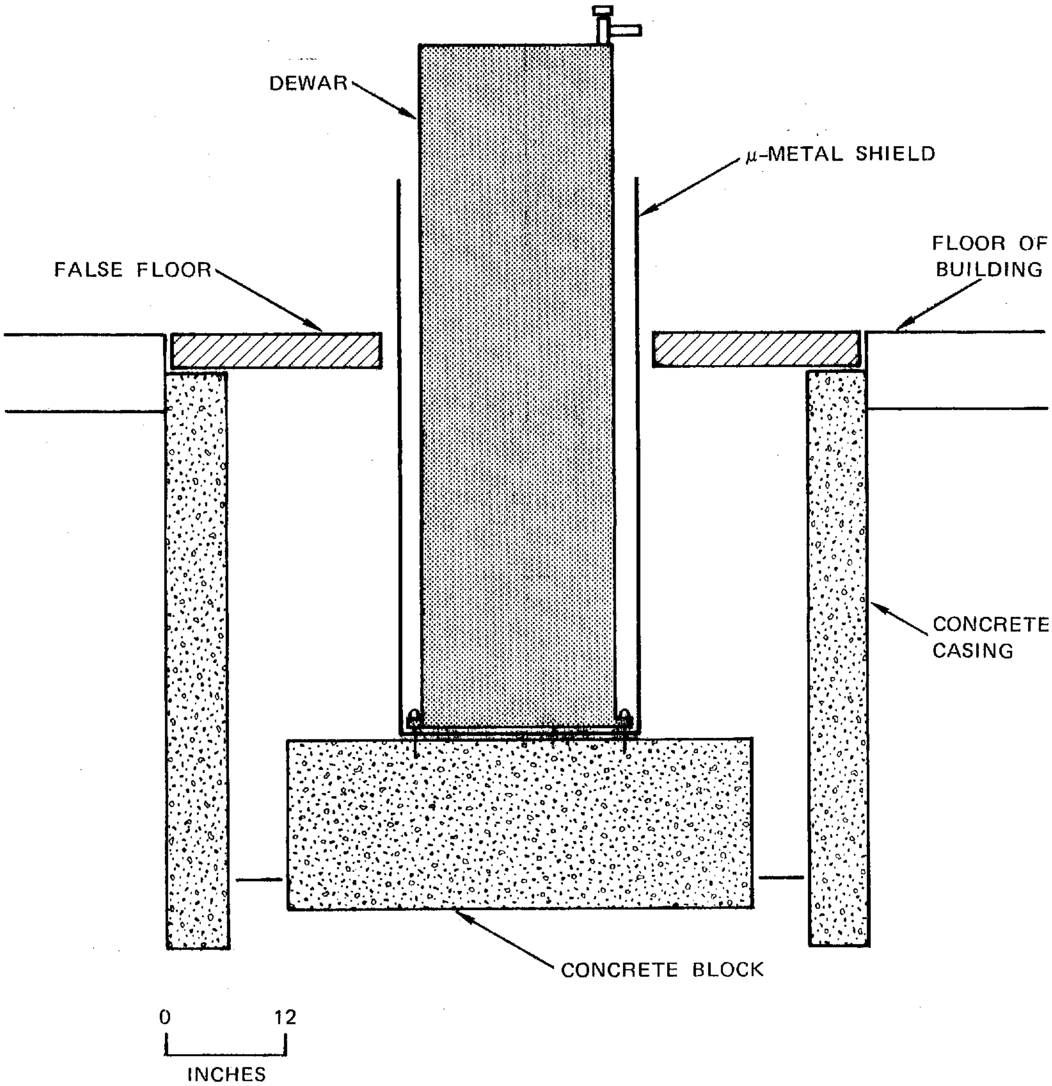

FIGURE 1 MAGNETOMETER HOUSING CONSTRUCTION

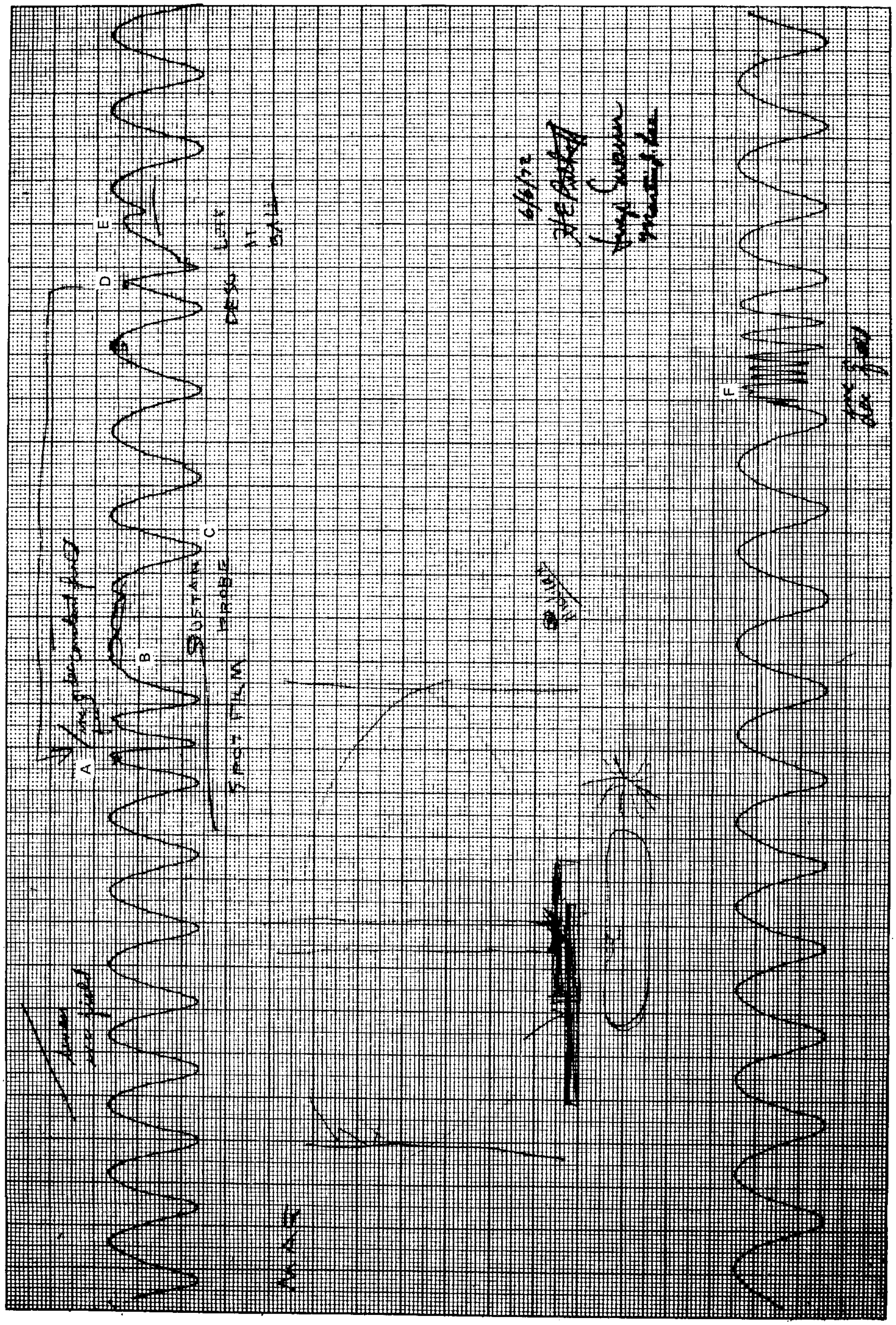

FIGURE 2 RAW DATA, MAGNETOMETER TEST RUN

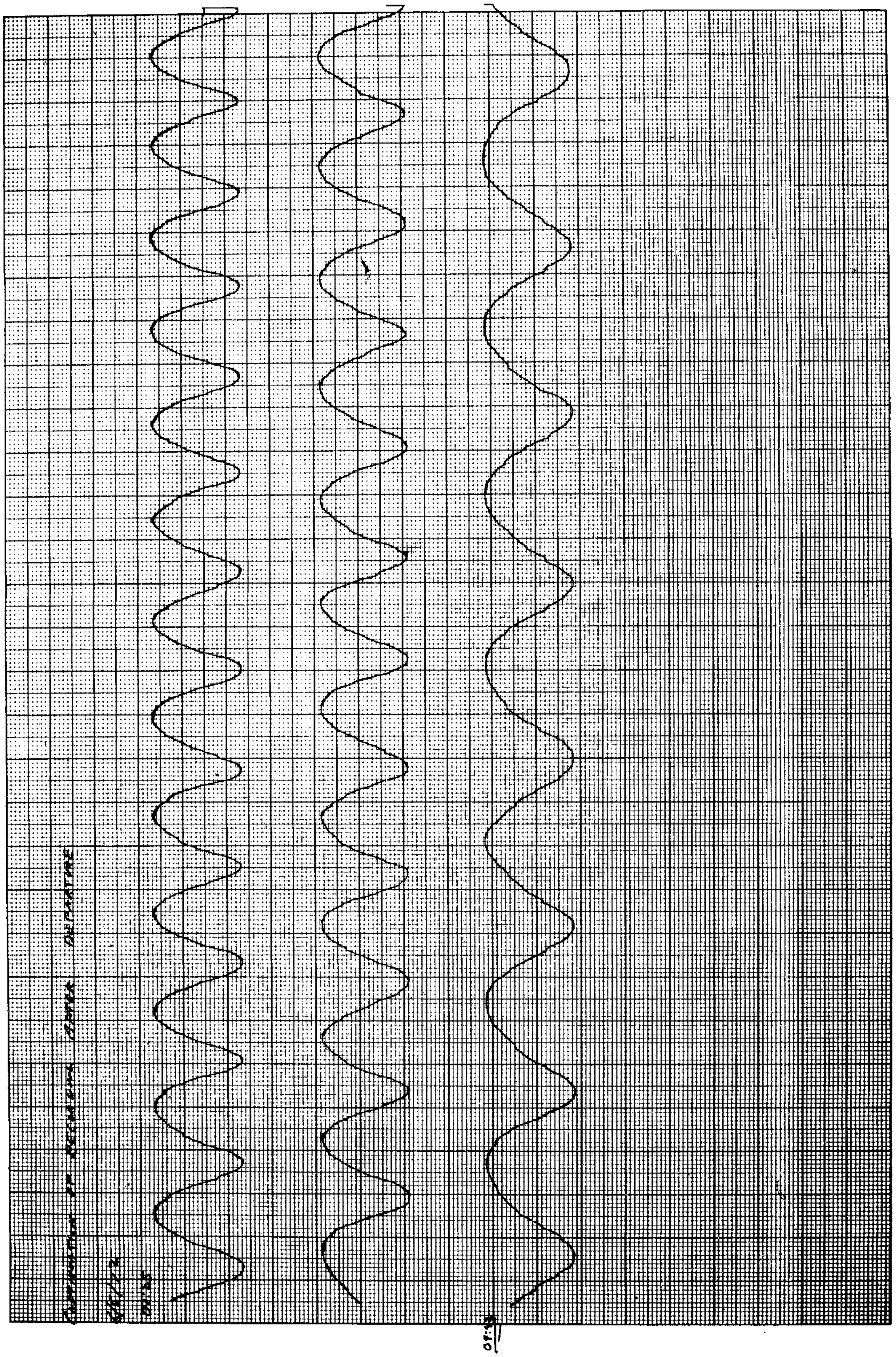

FIGURE 3 RAW DATA, MAGNETOMETER CONTROL RUN

The conditions of this observation, involving as it did a few hours use of an instrument committed to other research, prevented a proper investigation. The number of data samples was too few to permit meaningful statistical analysis, and the lack of readily available multiple recording equipment prevented investigation of possible "recorder only" effects. Therefore, the following longer term study with a similar device was undertaken.

B. Experiments with Superconducting Differential Magnetometer (Gradiometer)

A series of experiments was carried out using the superconducting second-derivative gradiometer* shown in Figure 4.

Basically, the gradiometer is a four-coil Josephson effect magnetometer device consisting of a pair of coil pairs wound so as to provide a series connection of two opposing first-derivative gradiometers, yielding a second-derivative gradiometer (that is, a device sensitive only to second- and higher-order derivative fields). As a result, the device is relatively insensitive to uniform fields and to uniform gradients. This arrangement allows for sensitive measurement of fields from nearby sources while discriminating against relatively uniform magnetic fields produced by remote sources. The device is ordinarily used to measure magnetic fields originating from processes within the human body, such as action currents in the heart that produce magnetocardiograms. The sensitive tip of the instrument is simply placed near the body area of interest.

In our experiment, however, the subject was located in an adjoining laboratory at a distance of 4 m from the gradiometer probe. As a result the subject was located in a zone of relative insensitivity; for example, standing up, sitting down, leaning forward, and arm and leg movements produced no signals. From this location the subject was asked, as a mental task, to affect the probe. The results of his efforts were available to him as feedback from three sources: an oscilloscope, a panel meter, and a chart recorder, the latter providing a permanent record.

A protocol for subject participation was instituted as follows. The subject removed all metal objects from his clothing and body, and the effects of body movements were checked at the start of each experimental period. The experimenter then announced the start of the experiment. A random number table (Rand) was then used to generate a sequence of ten subject ON and OFF periods of equal length (e.g., 25 seconds each). The subject was asked to make an effort to perturb the magnetometer during the ON periods, and to refrain from doing so during the OFF periods. The trace from the chart recording of a sample run (Run 1, Subject S1) is shown in Figure 5. The randomly generated ON (activity) periods occurred as Nos. 2, 8, and 9. As observed, signals appeared in each of these three periods. The signal appearing in Period 9 was strong

*Develco Model 8805, Develco, Inc., Mountain View, California.

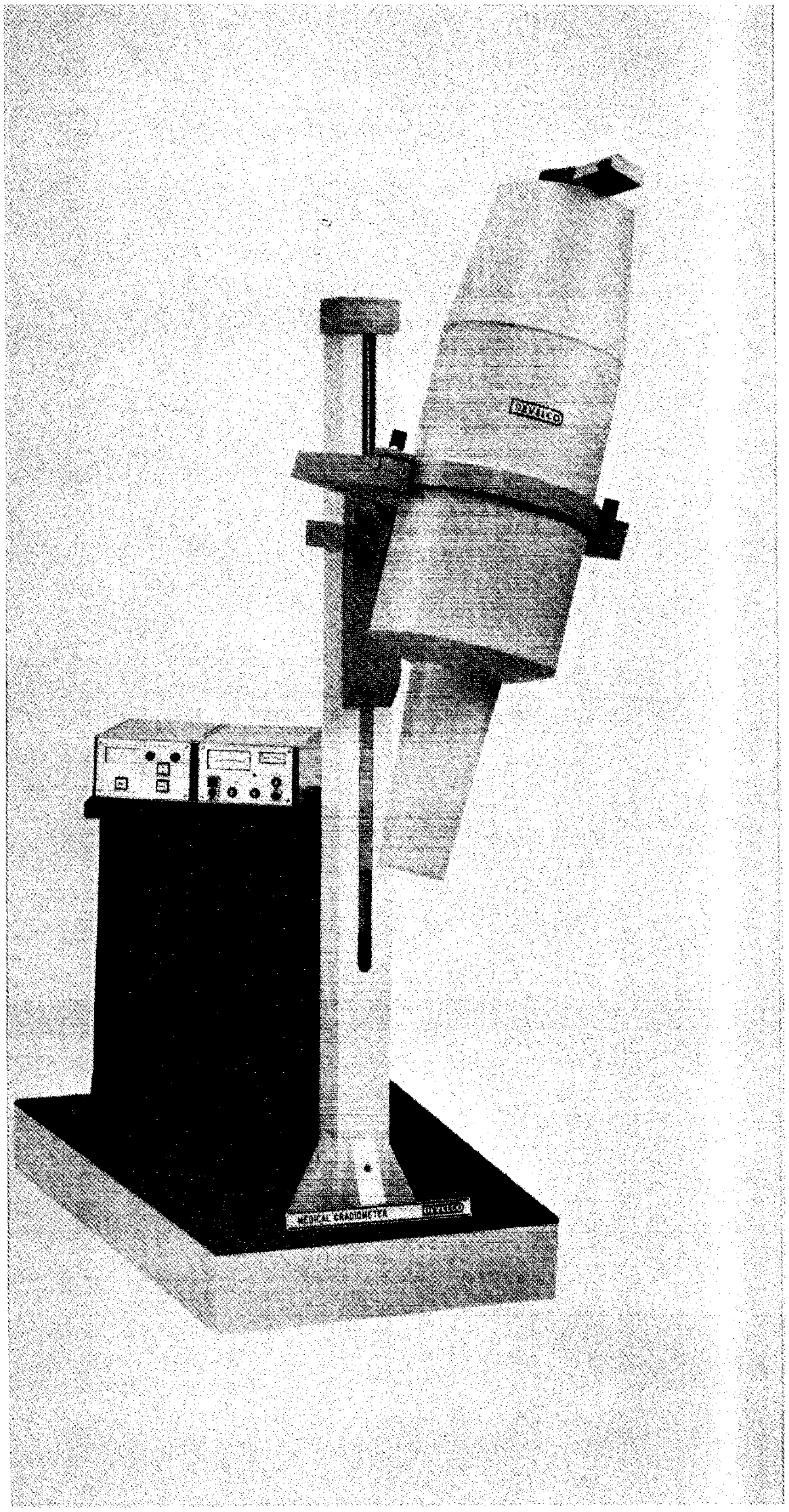

FIGURE 4 SUPERCONDUCTING DIFFERENTIAL MAGNETOMETER

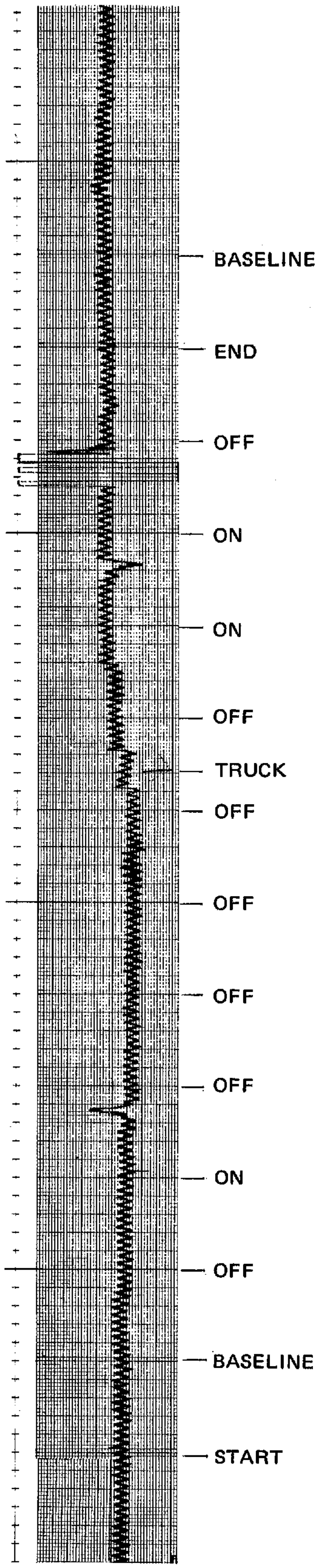

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FIGURE 5 GRADIOMETER DATA

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enough to cause loss of continuous tracking. This latter type of signal can be the result of an exceptionally strong flux change, or an RF burst, whether subject-generated or artifactual (i.e., noise); in any case, all signals are handled on the basis of statistical correlation as discussed below. An artifact due to the passage of a truck in the parking lot adjacent to the laboratory (under continuous surveillance by the experimenter) was noted in Period 6. Each of the signals on scale corresponds to an input of $\sim 1.6 \times 10^{-9}$ Gauss/cm^2 (second derivative $\partial^2 B_Z/\partial Z^2$), which is equivalent to $\sim 3.5 \times 10^{-7}$ Gauss referred to one pickup coil.

The interpretation of such observations must be subjected to careful analysis. For example, the emphasis on "corresponds to" is based on the following: although the probe is designed to register magnetic fields, and the simplest hypothesis is that an observed signal is such, in a task as potentially complex as human-mediated perturbation effects, one must be cautious about assigning a given observed effect to a specific cause. One can only conclude that generation of a magnetic field is the most probable cause. With regard to signal display, the signal was observed simultaneously on three recording devices at different stages of the electronics, and thus a "recorder only" effect can be considered low probability, although an electronics interference effect ahead of all display cannot be ruled out. We therefore treat the magnetic cause as tentative, although most probable, and concentrate our attention on whether a correlation exists between system disturbances and subject efforts.

Thirteen ten-trial runs were obtained with S1. Each of the ten trials in the run lasted 50 seconds,* the ON/OFF command for each trial being identified by a sequential run of even/odd digits in the Rand table of random numbers. In the 13 x 10 = 130 trials, consisting of a random distribution of 64 activity and 66 no-activity periods, 63 events of signal-to-noise ratio greater than unity were observed. Of these 63 events, 42 were distributed among the ON periods, 21 among the OFF periods, a correlation significant at the $p = 0.004$ level.

Two control subjects also interacted with the device. Although subject efforts and observed perturbations sometimes coincided, activity was generally low and did not appear to be the signature of correlated activity under control. A controlled ten-trial run with one subject and two such runs with another yielded nonsignificant results.

We therefore conclude that for subject S1 the observed number of precisely timed events in pilot work coupled with the statistically significant ($p = 0.004$) correlation between subject effort and signal output in controlled runs indicate a highly probable cause-effect relationship. Thus it appears that a subject can interact with a second derivative magnetic gradiometer of sensitivity $\sim 10^{-9}$ Gauss/cm^2 from a distance of 4 m. Further work would be required to determine the precise nature of the interaction, although given the equipment design the

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*With the exception of the first run where 25-second trials were used.

generation of a magnetic field is the most probable mechanism.

An independent successful replication of this experiment has been carried out by Dr. Richard Jarrard, Geology Department, University of California, Santa Barbara, using a single-coil cryogenic magnetometer.* The experiments, carried out with the subject in a room located 50 feet diagonally across a courtyard from the magnetometer room, resulted in events distributed across work and rest periods in ratio >3:1, respectively, paralleling our results.[4]

III PROPOSED PROGRAM

A. Objective

The objective of the proposed program is to investigate the characteristics of, and if possible to determine the mechanisms responsible for, human-subject mediated perturbation effects on a sensitive cryomagnetometer.

B. Statement of Work

Observations such as those reported in Section II require replication and study under as wide a variety of rigorously-controlled scientific conditions as possible. Therefore, we shall pursue further experimentation with a sensitive Josephson junction cryomagnetometer, a commercial instrument manufactured by Superconducting Technology, Inc., Mountain View, California.† The goal of such experimentation is the further delineation of the characteristics of the coupling mechanism under increasingly severe experimental conditions of distance and shielding.

To accomplish the proposed research objectives, SRI will furnish the personnel and facilities required for the following efforts.

- Obtain calibration data in control runs with Model A201 magnetometer (Superconducting Technology, Inc.) to establish baseline performance in absence of subject.
- Repeat above with various subjects present, but passive, to establish background of perturbation effects in the presence of subjects not engaging in volitional efforts to perturb magnetometer system.
- Carry out experimental runs of the type described in Section IIB, both with subjects having a history of perturbation capability and with control subjects. Effort/non-effort periods shall be

*Manufactured by Superconducting Technology, Inc., Mountain View, California.
†Model A201 magnetometer, employing an A401 SQUID sensor, A301 RF amplifier, and removable superconducting shield.

determined by random number generator to provide statistical control, and multiple recording apparatus shall be used to investigate "recorder only" effects.

- Assuming perturbation effects observed, interpose distance and shielding in a systematic study to determine dependence on these factors, to be carried out on a best-effort basis, given time and funds available.

- The exploratory nature of the program requires that 20 percent of the effort will be set aside to explore, with the client's cognizance, additional avenues of research that may surface as high-priority items during the course of the program.

SRI proposes to provide approximately 4.4 man-months of professional effort (including subjects) to accomplish the above objectives. Further, SRI personnel are consulting with other laboratories in various stages of replication of the original SRI experiment, and will keep the client apprised of results obtained elsewhere as well.

IV ESTIMATED TIME AND CHARGES

The estimated time required to complete this project and report its results is 13 months. The Institute could begin work on receipt of a fully executed contract.

Pursuant to the provision of ASPR 16-206.2, attached is a cost estimate and support schedules in lieu of the DD Form 633-4. Also enclosed is a signed form complete except as to the "Detail Description of Cost Elements."

V REPORTING SCHEDULE

Quarterly progress reports will be delivered on the tenth day following the end of each of the first three contract quarters. A final technical report will be delivered 13 months after the commencement date of the contract.

Throughout the program the investigators plan to remain in close communication with the client.

VI CONTRACT FORM

It is requested that any contract resulting from this proposal be written on a cost-plus-fixed-fee basis, and be awarded as a Supplemental Agreement to Contract No. N00039-76-C-0077.

VII ACCEPTANCE PERIOD

This proposal will remain in effect until 31 December 1975. If consideration of the proposal requires a longer period, the Institute will be glad to consider a request for an extension of time.

VIII SECURITY CLASSIFICATION

Stanford Research Institute holds a Top Secret Facility clearance, which may be verified through the cognizant military security agency, San Francisco Defense Contraction Administration Services Region, Attn: Office of Industrial Security, 866 Malcolm Road, Burlingame, California 94010. Staff assignments will be in accordance with the level of security assigned to the work.

IX QUALIFICATIONS OF SRI

SRI is an independent, nonprofit organization performing a broad spectrum of research under contract to business, industry, and government. The Institute, which was formerly affiliated with Stanford University, was founded in 1946. Its operations include the physical and life sciences, industrial and development economics, management systems, engineering systems, electronics and radio sciences, information science, urban and social systems, and various combinations of disciplines within these fields.

SRI has no endowment; payments by clients under research contracts and grants amount to approximately $80 million annually and are used to cover all operating costs. Such revenue also helps the Institute maintain the excellence of its research capabilities.

SRI's facilities include more than one million square feet of office and laboratory space and incorporate the most advanced scientific equipment, including unique instrumentation developed by the staff. The bulk of these facilities and most of the research staff are located at the Institute's headquarters in Menlo Park, California. Regional office locations include Washington, D.C.; New York City; Chicago; Houston; and Los Angeles.

Of SRI's total staff of almost 3,000, approximately one-half are in professional and technical categories. Some 450 members of the professional staff have PhD or equivalent degrees; 600 others have their Master's degree.

The project leader and other research personnel who would be active in the proposed work are members of the Electronics and Bioengineering Laboratory. This group currently occupies 40,000 square feet of laboratory space, divided into many separate laboratory rooms, technicians' work areas, a machine shop, and a computer room housing a LINC-8 and related terminals and equipment. In addition, a well-equipped computation center is available.

The Electronics and Bioengineering Laboratory employs a number of technicians and engineering assistants and has available electronics material and test equipment useful in the research proposed here. Especially suited to this work are a number of shielded rooms with various instrumentation available.

Finally, a backup team of psychologists and statisticians can be brought into the project on an internal consulting basis.

The proposed research will be conducted by SRI staff members within the Electronics and Bioengineering Laboratory under the direction of Mr. Earle Jones. The principal investigators will be Dr. Harold Puthoff and Mr. Russell Targ whose biographies are attached. Dr. Evan Harris Walker of Aberdeen Proving Ground and Dr. Ralph Kiernan of the Stanford University Medical School may be called on to act as consultants throughout this program.

In addition to the scientific personnel directly engaged in the research aspects of this investigation, SRI has established an internal technical advisory board. This board consists of several directors of SRI's operating divisions, together with our legal counsel, all under the chairmanship of the senior vice president for research. The function of this advisory board is not only to make recommendations and approve or disapprove every new direction taken by the Institute in this research area, but also to monitor related ongoing projects as well.

Next 2 Page(s) In Document Exempt

HAROLD E. PUTHOFF, SENIOR RESEARCH ENGINEER
ELECTRONICS AND BIOENGINEERING LABORATORY
INFORMATION SCIENCE AND ENGINEERING DIVISION

Specialized professional competence

- Tunable laser research and development; quantum electronics; biofeedback and biomeasurement research; "paranormal" perception

Representative research assignments at SRI

- Development of tunable ultraviolet laser source for pollution studies and medical research
- Development of high-power tunable infrared laser source (50-250 microns) for materials research
- Assessment of potential of fiber optics and lasers for use in optical computers
- Development of biofeedback monitors (GSR) for use in educational computers and other man-machine links
- Research and development of biofield measurements
- Investigation of "paranormal" perceptual abilities

Other professional experience

- Research associate, Hansen Laboratories of Physics and lecturer, Department of Electrical Engineering, Stanford University: teaching, textbook author, and research supervisor of Ph.D. candidates in the area of lasers and nonlinear optics
- Consultant on applications of lasers to industrial and medical problems and research assistant, Stanford University
- Lieutenant, USNR: in-house research and contract monitoring on DoD (NSA) contracts concerned with the development of ultra high-speed (GHz) computers
- Research engineer, Sperry Electronic Tube Division and Sperry fellow, University of Florida: design and testing of electron beam focusing systems for use in microwave tubes

Academic background

- B.E.E. (1958) and M.S.E. (1960), University of Florida; Ph.D. in electrical engineering (1967), Stanford University

Publications and patents

- Coauthor of textbook, *Fundamentals of Quantum Electronics* (Wiley); three reference book contributions; twenty-five papers in professional journals; seventeen national symposium papers; numerous technical reports
- Two patents

Professional associations and honors

- American Association for the Advancement of Science; Institute of Electrical and Electronics Engineers; Phi Eta Sigma; Phi Kappa Phi; Sigma Tau; Sigma Xi

RUSSELL TARG, SENIOR RESEARCH PHYSICIST
ELECTRONICS AND BIOENGINEERING LABORATORY
INFORMATION SCIENCE AND ENGINEERING DIVISION

Specialized professional competence

- Development of new gas lasers; FM laser and supermode laser techniques; laser noise reduction; optical modulation and demodulation; experiments in new gaseous laser media; microwave diagnostic techniques; microwave generation from plasmas

Professional experience

- Sylvania Corporation (1962-72); investigation of techniques for development of new gas lasers, making use of his research with compact, self-contained multi-kilowatt CO_2 lasers
- Technical Research Group (1959-62); experiments in new gaseous laser media
- Polytechnic Institute of Brooklyn; assisted in the establishment of the Electron Beam Laboratory
- Sperry Gyroscope Company, Electron Tube Division (1956-59); experimental work in microwave generation from plasmas; early work in the technology of ultrahigh-vacuum and ion-pump design

Academic background

- B.S. in physics (1954), Queens College, New York; graduate work in physics (1954-56), Columbia University, New York

Publications and inventions

- Author of "Optical Heterodyne Detection of Microwave-Modulated Light," *Proc. IEEE* (1964); coauthor of numerous articles on lasers and plasma oscillations
- Invention of the tunable plasma oscillator at microwave frequencies

Professional associations and honors

- IEEE; American Physical Society; The Optical Society of America
- Awarded the position of research associate with the Polytechnic Institute of Brooklyn

REFERENCES

1. H.E. Puthoff and R. Targ, "Physics, Entropy, and Psychokinesis," Proc. 23rd Annual Conference, Quantum Physics and Parapsychology, August, 1974, Geneva, Switzerland (Parapsychology Foundation, New York, 1975).

2. R. Targ and H.E. Puthoff, "Information Transmission Under Conditions of Sensory Shielding," Nature 252, No. 5476, pp. 602-607, October 18, 1974. Reprinted in the IEEE Communications 13, January, 1975

3. H.E. Puthoff and R. Targ, "A Perceptual Channel for Information Transfer Over Kilometer Distances: Historical Perspective and Recent Research," Proc. IEEE (In press). See also "Remote Sensing Techniques," SRI proposal for research SRI No. ISU 75-73 (C

4. R. Jarrard, K. Corcoran, R. Mayfield, and R. Morris, "PK Experiments with Cryogenic Magnetometer," Research brief presented at the 18th Annual Convention of the Parapsychological Association of the American Association for the Advancement of Sciences, Santa Barbara, California, August, 1975.